Warren Smith & Partners

10 September 2020

CIVIL ENGINEERING SERVICES

SGS WEIGALL SPORTS COMPLEX & CAR PARK

Civil & Stormwater State Significant Development Application (SSDA) Report

SSD-10421

Hydraulic Fire Civil Utilities Infrastructure

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APPROVALS

01	Martyna Czarnota *Graduate Engineer – Civil & Water Engineering*	Laura Shaughnessy *Partner – Civil & Water Engineering*
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EXECUTIVE SUMMARY

A 3-storey sports complex and 2-3 split level parking garage is proposed as part of the existing overall Weigall Sports Complex development. The proposed SGS Weigall Sports Complex will require a Sydney Water (SWC) sewer asset deviation and a Woollahra Municipal Council stormwater asset deviation. Refer to Figure 0-1 for the proposed deviations.

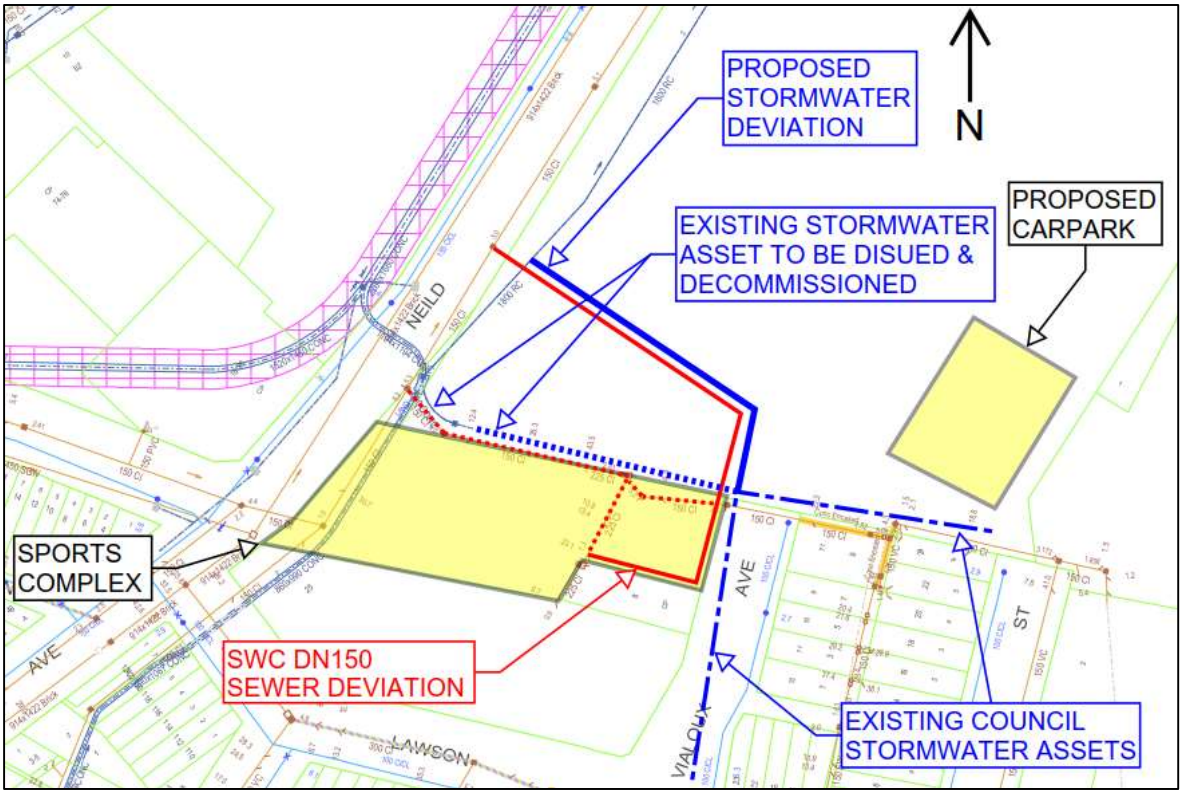

Figure 0-1 Overall Utility Connection and Deviations

It is proposed that stormwater runoff from the hardstand and landscape areas surrounding the new sport complex be captured via a new pit and pipe network which will discharge into the existing council owned stormwater kerb inlet pit located adjacent the existing driveway in Nield Avenue.

It is proposed that the new Sport Complex building itself will discharge to a 100 kL rainwater reuse tank located beneath the terrace at the north side of the building which will be drawn from for irrigation and WC flushing. The rainwater reuse tank will overflow to a 22 kL OSD tank which will discharge to the new DN600 stormwater deviation.

The eastern carpark building, and surrounding landscape and hardstand areas will also discharge to the proposed DN600 stormwater deviation.

The proposed water quality treatment plan includes three (3) different products by Ocean Protect: OceanGuard and 690mm PSORB Stormfilter, and one product by MyCelx: Oil Soak.

- It is proposed that a total of fifteen (15) proposed grated inlet stormwater pits be fitted with OceanGuard filter baskets.
- It is proposed that a total twenty three (23) Ocean Protect 690mm PSORB Stormfilters be installed throughout the proposed stormwater system.
- It is proposed that one OceanGuard basket located in the eastern external carpark will be fitted with one (1) Oil Soak supplied by MyCelx to remove oil and hydrocarbons from stormwater runoff.

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SCHEDULES

CIVIL ENGINEERING SERVICES

1. INTRODUCTION

Warren Smith & Partners Pty Ltd (WS+P) has been engaged by Jattca Strategy Property Solutions (Jattca) on behalf of Sydney Grammar School (SGS) to prepare a civil and stormwater report for the State Significant Development Application (SSDA) submission associated with the proposed Weigall development. The new development consists of a new sports complex in place of the existing tennis courts off Neild Avenue and a new two levels open carpark in place of the existing squash fields located at the south eastern corner of the SGS property. This report aims to address the following:

- Proposed Site Levels;
- Council Stormwater Deviation;
- Sydney Water Sewer Deviation;
- Private Stormwater Drainage System;
- On-Site Detention (OSD) System;
- Proposed Connection to Existing & Proposed Stormwater Infrastructure;
- Water Sensitive Urban Design (WSUD) Requirements, and;
- Sediment and Erosion Control.

1.1 SITE LOCATION

The SSDA development site is part of the Weigall Playing Fields located on Neild Avenue at Rushcutters Bay. Please refer to Figure 1.1 for an aerial view of the proposed development site.

Weigall is bound by the following:

- Neild Avenue to the west (Neild Avenue is classified as a collector road and forms part of the State Road MR625 managed by Roads and Maritime Services)
- State Rail land and the Eastern Suburbs Railway viaduct to the north
- White City (Hakoah Club and Maccabi Tennis Club), SGS Edgecliff Preparatory School, Vialoux Avenue, Alma Street, and residential development to the south
- Residential properties to the south and north-east
- A Sydney Water (SWC) stormwater channel which traverses the site
- A right of way from Alma Street, benefiting the site, which crosses the site formerly known as White City.

Please refer to Figure 1.1 for an aerial view of the proposed development site.

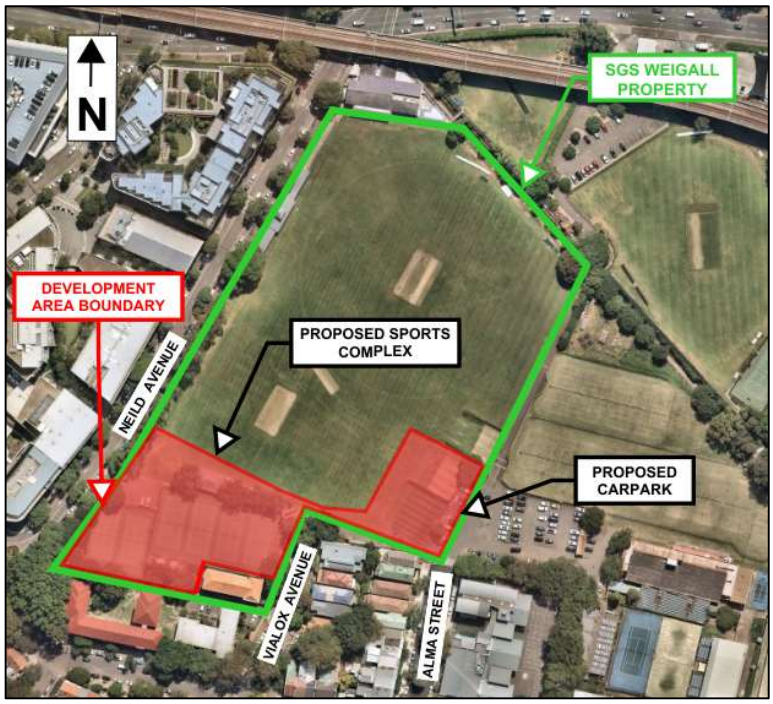

Figure 1.1: Aerial View of Proposed Development Site Area (Source: Near Map)

1.2 SCOPE OF THE PROJECT

The state significant development includes the following:

a) Demolition of the following existing structures and buildings (which are not heritage significant) at the southern edge of the SGS Weigall Playing Fields:
- Multipurpose/tennis courts and associated fencing;
- Barry Pavilion;
- The existing cricket nets off Alma Street, and;
- Paved car park near Neild Avenue.

b) Construction of the SGS Weigall development comprising the following:
- Building 1 accommodating the following facilities:
  - Ground floor: Main pool, programme pool, terrace/assembly facing Weigall, entry foyer, offices, change rooms back of house and five car parking spaces and loading dock;
  - First floor: Multipurpose sports hall 01 – basketball, multipurpose sports hall 02 – cardio, weights, taekwondo, changerooms, storage and services;
  - Level 2: Multipurpose room 04; multipurpose sports hall 03 – cardio, weights, taekwondo and services, and;
  - Driveway entry from Neild Avenue.
- Building 2 comprising a new car park accommodating 118 spaces over 2-3 split levels, accessed from Alma Street;
- Landscaping of the site including tree removal/replacement, fencing and lighting, and;
- Building identification signage.

c) Use of the completed building as an educational establishment with external/community use of the proposed facilities that coordinate with the programming of the SGS.

The proposal does not include any classrooms or an increase in the existing student population.

2. ABBREVIATIONS AND DEFINITIONS

AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARR	Australian Rainfall and Runoff
CCC	Central Coast Council
DN	Diameter Nominal (mm)
EY	Exceedances per Year
GPT	Gross Pollutant Trap
IFD	Intensity-Frequency-Duration
IL	Invert Level
L/s	Litres per second
m/s	Metres per second
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
OSD	On-Site Detention
PSD	Permissible Site Discharge
RCP	Reinforced Concrete Pipe
RL	Reduced Level
RWT	Rainwater Reuse Tank
WS+P	Warren Smith and Partners
WSUD	Water Sensitive Urban Design

The Use of Must, Shall & Should:

In accordance with the International Organisation for Standardisation (ISO) Directives, the word “shall” is used to state that a requirement is strictly to be followed in order to conform to a Performance Requirement. Consequently, there can be no deviation from that requirement, other than a specific tolerance.

It is noted that in legislation and specifications it is common to use the word “must” to express a requirement. The word “shall” in this document should be considered as equivalent to “must” in the legislation.

The word “should” introduces a suggestion or recommendation that is not a requirement. It is not necessary that such recommendations or suggestions be followed in order to comply with the Performance Requirement.

3. EXISTING DRAINAGE INFRASTRUCTURE & PROPOSED INFRSTRUCTURE DEVIATIONS

3.1 EXISTING DRAINAGE INFRASTRUCTURE & SITE GRADING

A desktop review and site walkover were carried out by WS+P to determine the existing drainage infrastructure within the development site. The walkover and desktop review revealed the following:

- The proposed sports complex development area grades at approximately 1% in a north-easterly direction across the existing tennis courts, with an existing embankment grading at 20-25% along the northern edge of the proposed development where levels drop down to the existing Weigall fields;
- The proposed carp development area grades at approximately 1.3% in a north-westerly direction;
- There is one (1) DN600 council stormwater drainage line that traverses the site from Vialox Avenue reticulating towards Neild Avenue connecting into an existing 600CONC Sydney Water stormwater asset within the development site, which discharges to two separate Sydney Water assets as follows:
    - An existing 1800RC Sydney Water stormwater asset that reticulate in a northerly direction within the SGS property, and
    - A 1194x1194CONC Sydney Water asset that reticulates west into Neild Avenue
- There are several private and authority owned stormwater pits located within and in the vicinity of the proposed development, and;
- There is one (1) Council owned stormwater kerb inlet pit located in Neild Avenue where a portion of the stormwater drainage for the proposed development shall connect to.

3.1.1 PROPOSED COUNCIL STORMWATER DEVIATION

The Council stormwater deviation will be deviated around the proposed sports complex footprint, along the east and north of the development area. The existing stormwater asset being deviated is a DN600 asset. Approximately 71m of the existing asset to be deviated is Council owned with the remaining approximately 13m being SWC owned. It is proposed that the deviation will connect and discharge into an existing DN1800 SWC owned asset that reticulates north along the western boundary of the SGS property. Details of the proposed deviation will be submitted to SWC within the development's Section 73 Notice of Requirements application so that SWC can review and provide direction as to the required sizing for the proposed stormwater deviation.

Upon completion of the deviation, it is proposed that the existing Council asset be disused and removed while approximately 9m of the existing SWC asset will be discussed and removed. The remainder of the existing SWC asset will be capped.

Following receipt of SWC's advice, the detailed design of the proposed stormwater deviation will be developed and submitted to Council for approval. Ongoing communication will also be maintained with SWC.

Refer to Figure 3.1 for an illustration of the site grading, the location of the existing stormwater infrastructure and proposed stormwater deviation.

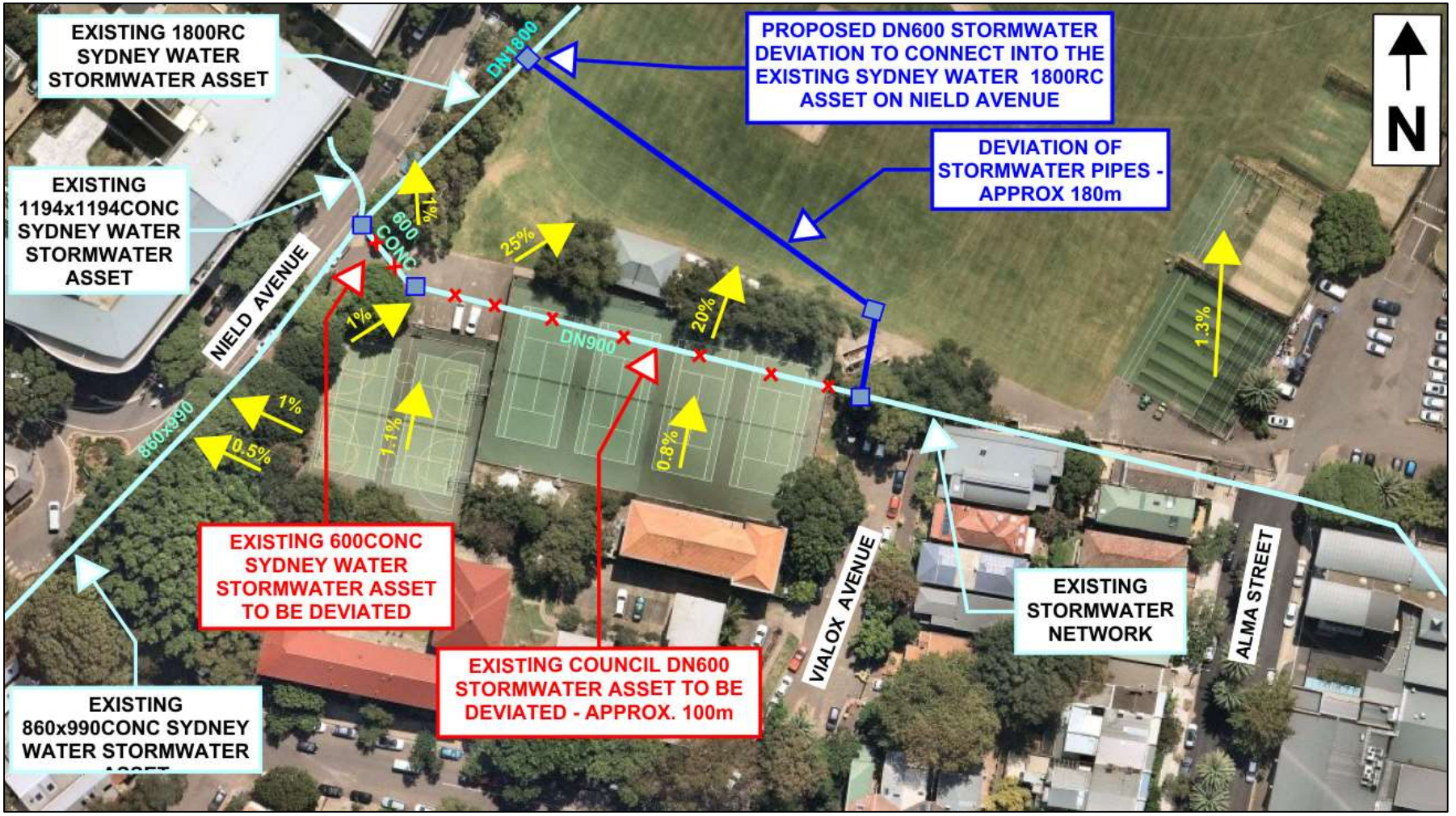

Figure 3.1: Aerial View of Existing Stormwater Infrastructure and Proposed Stormwater Deviation

3.2 EXISTING SYDNEY WATER SEWER INFRASTRUCTURE

A desktop review was carried out by WS+P to determine the existing sewer infrastructure within the development site. The desktop review revealed the following:

- There are two (2) DN150 and DN225 Sydney Water sewer lines that traverses the site from Vialox Avenue immediately west of the proposed development prior to connecting into an existing sewer manhole in Neild Avenue, and;
- There are seven (7) Sydney Water sewer manholes located within the vicinity of the proposed development.

3.2.1 PROPOSED SEWER DEVIATION

It is proposed that the existing DN150/225 Sydney Water sewer be deviated around the proposed sports complex footprint, along the east and north of the development area, connecting into an existing Sydney Water DN150 sewer pipe located in Neild Avenue. The length of the proposed sewer deviation is approximately 160m. The existing sewer DN150 and DN225 pipework, and manholes located within the proposed building footprint shall be decommissioned and removed.

Please refer to Figure 3.2 for an illustration of the proposed SWC DN150 sewer deviation.

Figure 3.2: Aerial View of Existing Sewer Infrastructure and Proposed Sewer Deviation

The detailed design of the proposed sewer deviation will be submitted to SWC for approval and the appropriate processes will be followed in accordance with the SWC requirements.

4. AUTHORITY AND REGULATORY REQUIREMENTS

With reference to the following documents, the Woollahra Municipal Council requirements are as outlined in the sub-sections below:

- Woollahra Municipal Council Development Control Plan 2015, Chapter E2 Stormwater and Flood Risk Management, dated 23 May 2015;
- Woollahra Municipal On-Site Detention Exemption Area, and;
- Woollahra Municipal Council Development Application Guide.

4.1 STORMWATER DEVIATION REQUIREMENTS

- Where an overland flow system is not available, the diverted drainage system shall be designed to cater for a minimum 1 in 100 Average Recurrence Interval (ARI) storm event;
- Where an overland flow system is available, the diverted drainage system shall be designed to cater to a minimum 1 in 20 ARI storm event; and the drainage system, in combination with the overland flow system, is designed to cater to a minimum 1 in 100 ARI storm event, and;
- If Council's existing drainage system is diverted onto private land, an easement shall be created in favour of Council.

4.2 STORMWATER DRAINAGE AND ON SITE DETENTION (OSD) REQUIREMENTS

- Properties, regardless of the development type, located within Council's OSD exemption area are not required to install OSD. Refer to Figure 4.1 for the OSD Exemption Area and location of the proposed development within this exempt area.

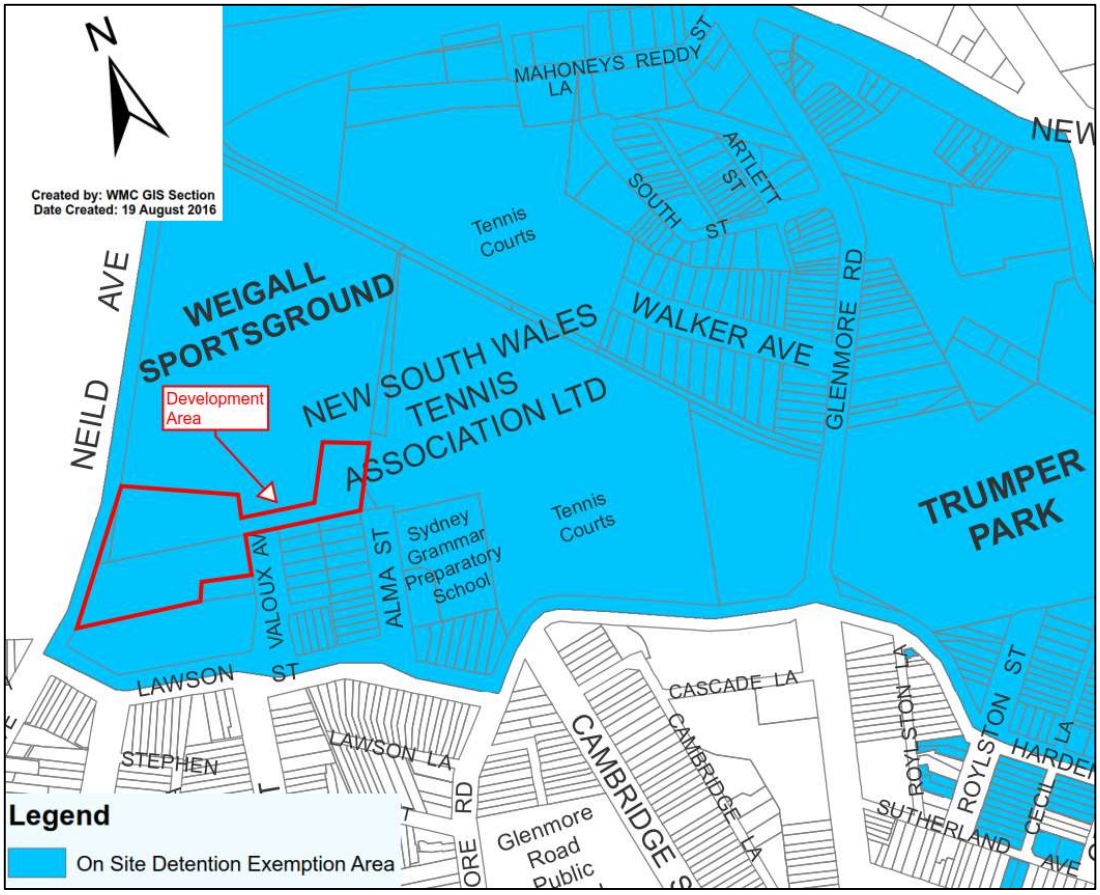

Figure 4.1: OSD Exemption Area and Location of the Proposed Development Site

- Where an overland flow system is not available, the drainage system shall be designed to cater to a minimum 1 in 100 ARI storm event;
- Where an overland flow system is available, the drainage system shall be designed to cater to a minimum 1 in 20 ARI storm event; and the drainage system, in combination with the overland flow system, shall be designed to cater to a minimum 1 in 100 ARI storm event.
- The connection from the development site to Council's below ground drainage system shall be a direct route and shall be generally laid perpendicular to the line of the kerb and gutter.

Additional requirement from the *Consultant Advice Note SGS Weigall Sports Complex Environmentally Sustainable Design (ESD) Framework, dated May 29, 2020* are as follow:

- The post development peak event stormwater discharge from the site does not exceed the predevelopment peak event stormwater discharge, using Average Recurrence Interval (ARI).
- Adopt a 20% increase in rainfall intensities to account for changing climate patterns.

4.3 FREEBOARD REQUIREMENTS

- Habitable floor levels are to be set at, or above the 100 Year ARI flood level plus 0.5m freeboard;
- Non-habitable floor levels are to be set at, or above the 100 Year ARI flood level plus 0.3m freeboard;
- Ground level, open car parking spaces are to be set at, or above the 20 Year ARI flood level plus 0.3m freeboard, and;
- Enclosed car parking spaces, more than three vehicles are to be set at, or above the 100 Year ARI flood level plus 0.3m freeboard.

4.4 WATER SENSITIVE URBAN DESIGN (WSUD) REQUIREMENTS

- A rainwater tank may be installed as an alternative to all or part of the OSD requirements for any development type. The capacity of the rainwater tank is 1.5 times the OSD volume requirements.
- The rainwater tank is at least 6m³ per 100m² of impervious area across the site.

Refer to Table 4.1 for the stormwater quality reduction targets to be achieved for the proposed site.

Table 4.1: WSUD Stormwater Quality Reduction Targets as per Woollahra DCP.

Pollutant Type	Reduction Target (%)
Gross Pollutants (GP)	90%
Total Suspended Solids (TSS)	85%
Total Phosphorus (TP)	65%
Total Nitrogen (TN)	45%

Additional requirements from *Consultant Advice Note SGS Weigall Sports Complex ESD Framework, dated May 29, 2020* are presented in Table 4.2.

Table 4.2: WSUD Stormwater Quality Reduction Targets as per ESD Framework

Pollutant Type	Reduction Target (%)
Free Oils	90%
Total Petroleum Hydrocarbons (TSS)	60%

5. PROPOSED STORMWATER SYSTEM

The total site development area is 0.8124 Ha. A breakdown of the proposed development area is presented in Table 5.1.

Table 5.1: Breakdown of Proposed Development Site Catchment

Catchment	Impervious (Ha)	Pervious (Ha)	Total Area (Ha)
Landscape & Hardstands	0.19542	0.05598	**0.2514**
Roof	0.5342	-	**0.5342**
Bypass	0.0089	0.0179	**0.0268**
Total Area	**0.73852**	**0.07388**	**0.8124**

It is proposed that stormwater runoff from the hardstand and landscape areas surrounding the new sport complex be captured via a new pit and pipe network which will discharge into the existing council owned stormwater kerb inlet pit located adjacent the existing driveway in Nield Avenue.

It is proposed that the new Sport Complex building itself will discharge to a 100 kL rainwater reuse tank located beneath the terrace at the north side of the building which will be drawn from for irrigation and WC flushing. The rainwater reuse tank will overflow to a 22 kL OSD tank which will discharge to the new DN600 stormwater deviation. Refer to Figure 5.1 Sport Complex Stormwater Plan for OSD location and discharge points.

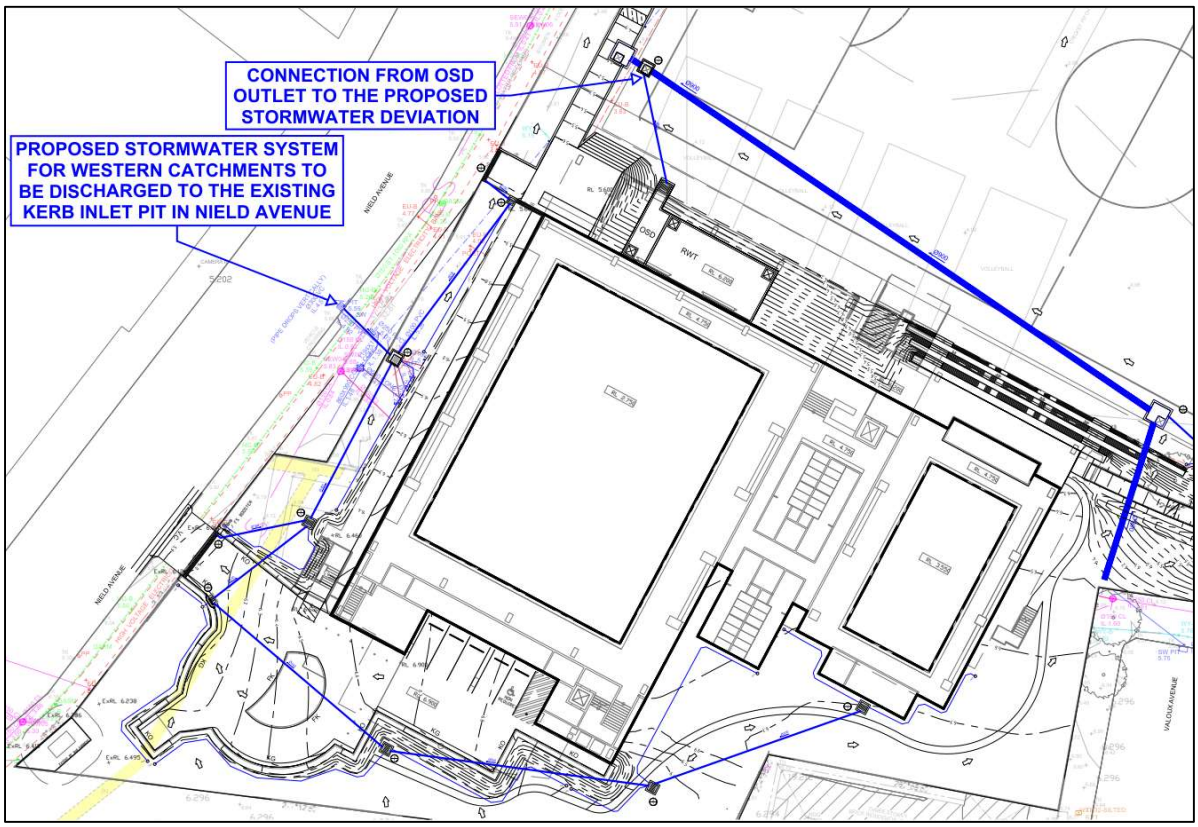

Figure 5.1: Proposed Sports Complex & Western Catchments Discharge Point

The eastern carpark building, and surrounding landscape and hardstand areas will also discharge to the proposed DN600 stormwater deviation. Please refer to Figure 5.2 for an illustration of the proposed drainage and discharge point.

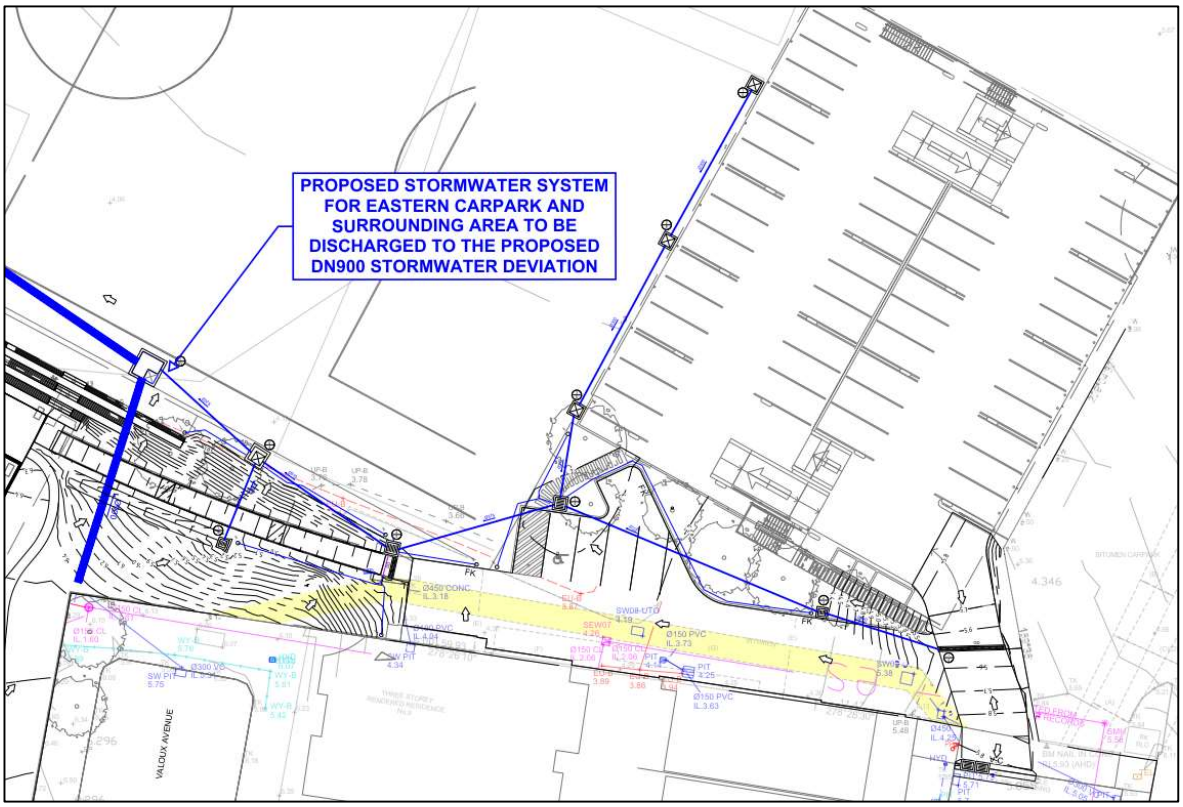

Figure 5.2: Proposed Carpark Building & Eastern Catchments Discharge Point

5.1 STORMWATER SYSTEM DESIGN

5.1.1 DRAINS INPUT PARAMETERS

The drainage system has been modelled utilising DRAINS to ensure the system is designed to meet Council and the ESD framework stormwater requirements. DRAINS is a stormwater drainage design and analysis program which performs hydraulic grade line analysis and generates the flows which would occur for a particular Annual Exceedance Probability (AEP) storm event.

The catchment characteristic factor values which have been used in the DRAINS model are summarised below:

- Paved (impervious) Area Depression Storage 1mm
- Supplementary Area Depression Storage 1mm
- Grassed (Pervious) Area Depression Storage 5mm
- Soil Type - Normal 3.0
- Antecedent Moisture Condition (AMC) 3.0
- Minimum Pit Freeboard 300mm
- Blockage Factor for On-Grade Pits 20%
- Blockage Factor for Sag Pits 50%

We have applied a 20% increase to the rainfall intensities to account for changing climate patterns in order to satisfy the EDS requirements for the development.

5.1.2 OSD TANK DETAILS

To satisfy the ESD Framework requirements, which states that post development discharge flows shall not exceed the predevelopment discharge flows, it is proposed that OSD will be incorporated into the proposed stormwater drainage design. It is proposed that the OSD be located beneath the terrace to the north site of the sports complex building and will capture the overflow from the proposed 100 kL rainwater tank whose catchment include the sport complex roof area of 0.3339 Ha. Refer to Table 5.2 for the OSD tank details and Figure 5.3 for the location of OSD Tank.

Table 5.2: OSD Tank Details

Item	Detail
Total Catchment Area Draining to the OSD Tank (Ha)	0.3339 Ha
Percentage of total development area bypassing OSD Tank (%)	58.90%
Effective Depth (m)	1.16m
Low Level Orifice Diameter (mm)	253 mm
High Level Orifice Diameter (mm)	300 mm
OSD Top Water Level (RL mAHD)	5.20
Calculated OSD Tank Volume Effective (m^3)	21.57 m^3

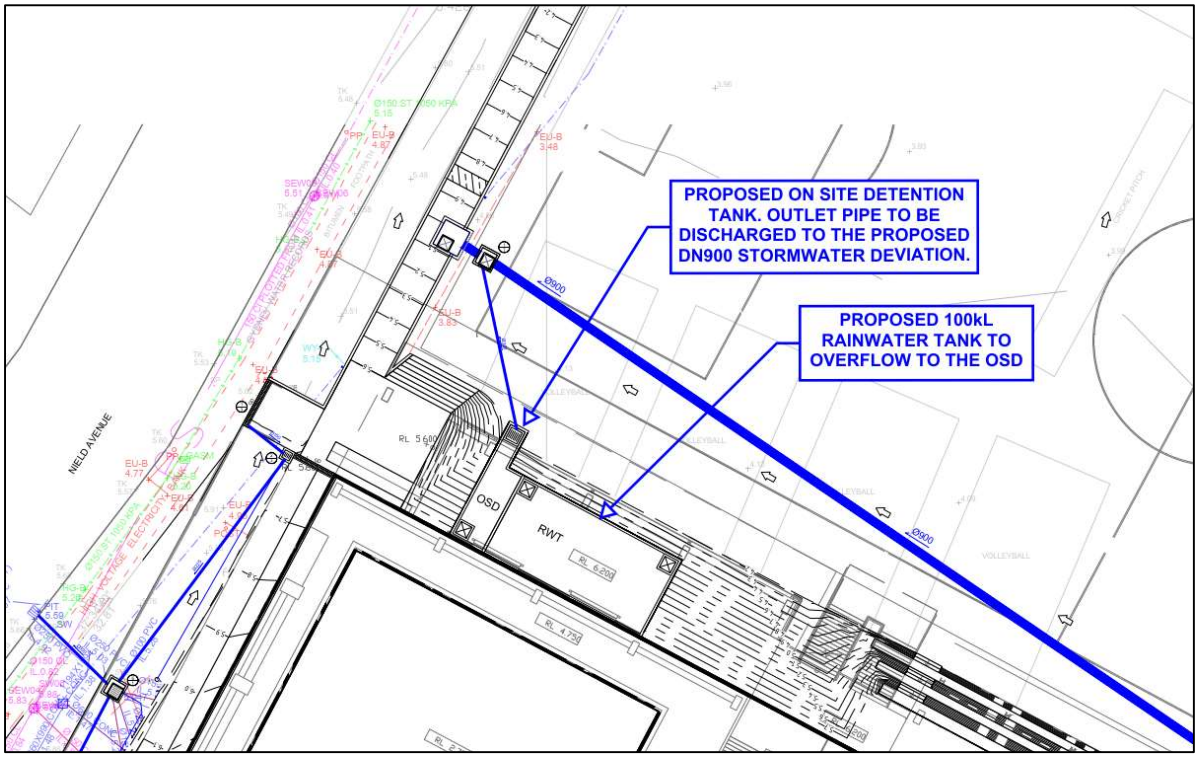

Figure 5.3: On Site Detention Tank and Rainwater Tank location.

5.2 RESULTS

The development area's OSD tank has been designed to ensure that the post development stormwater runoff from the total development area does not exceed the pre-development runoff. Refer to Table 5.3 for the development area's site discharge results.

Table 5.3: Development area's site discharge results.

Scenario	50% AEP Storm Event (L/s)	20% AEP Storm Event (L/s)	10% AEP Storm Event (L/s)	5% AEP Storm Event (L/s)	2% AEP Storm Event (L/s)	1% AEP Storm Event (L/s)
Pre-Development	204	295	376	457	574	666
Post Development	203	285	368	430	509	550

6. WATER QUALITY REQUIREMENTS & PROPOSED STORMWATER TREATMENT SYSTEM

In order to comply with the Woollahra Municipal Council's requirements for the adequate treatment of stormwater runoff, treatment solutions have been provided to remove suspended solids, hydrocarbons, and nutrients, prior to being discharged from site.

The pollutants that could potentially be generated as a result of the development are as follows:-

- Litter;
- Sediments;
- Nutrients (Phosphorus and Nitrogen), and;
- Hydrocarbons.

The development has been modelled to demonstrate the performance of the stormwater treatment system utilising a program called MUSIC. MUSIC models the proposed stormwater treatment devices and estimates their respective performance against the performance targets of the project. The pollutants modelled in MUSIC are Gross Pollutants (GP), Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

6.1 RAINFALL

The average potential evapotranspiration (PET) data used in the MUSIC model was based on the average Sydney PET and is presented in Table 6.1 below.

Table 6.1: Evapotranspiration Data for MUSIC Modelling

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PET (mm)	180	135	128	85	58	43	43	58	88	127	152	163

6.2 RAINFALL RUNOFF PROPERTIES

Table 6.2 and Table 6.3 presents the rainfall runoff properties which have been used in the MUSIC model.

Table 6.2: MUSIC Rainfall Runoff Properties

Parameter	Unit	Value
Impervious Area Parameters		
Rainfall Threshold	mm	0.3 (for roofs) 1.5 (for landscaped areas) 1.5 (for roads)
Pervious Area Parameters		
Soil Storage Capacity	mm	350
Initial Storage Capacity	%	30
Field Capacity	mm	144
Infiltration Capacity co-efficient a		360
Infiltration Capacity co-efficient b		0.5
Groundwater Properties		
Initial depth	mm	10
Daily recharge rate	%	100
Daily base seepage rate	%	50
Daily seepage rate (%)	%	0

Table 6.3: Pollutant Concentration Parameters for MUSIC Source Nodes

Land Use Category		Concentration (mg/L-log$_{10}$)					
		Total Suspended Solids		Total Phosphorus		Total Nitrogen	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
General Urban (incl. public open space)	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Standard Deviation	0.32	0.17	0.25	0.19	0.19	0.12
Sealed Roads	Mean	2.43	*	-0.30	*	0.34	*
	Standard Deviation	0.32	*	0.25	*	0.19	*
Roofs	Mean	1.30	*	-0.89	*	0.30	*
	Standard Deviation	0.32	*	0.25	*	0.19	*

*Base flows are only generated from pervious areas; therefore, these parameters are not relevant to impervious areas.

6.3 MUSIC MODEL CATCHMENT AREAS AND STORMWATER TREATMENT PLAN

The MUSIC model's total catchment area to be treated is 0.8124 Ha. Refer to Table 6.4 for a breakdown of the MUSIC model catchment areas.

Table 6.4: Breakdown of MUSIC Model Catchment

Catchment	Impervious (Ha)	Pervious (Ha)	Total Area (Ha)
Landscape & Hardstands	0.19542	0.05598	**0.2514**
Roof	0.5342	-	**0.5342**
Bypass	0.0089	0.0179	**0.0268**
Total Area	**0.73852**	**0.07388**	**0.8124**

The proposed site treatment will utilise three (3) different products by Ocean Protect: OceanGuard and 690mm PSORB Stormfilter, and one product by MyCelx: Oil Soak.

The first level of treatment will consist in OceanGuards. OceanGuards will intercept surface runoff at the pit grates and filter the runoff prior to entering the piped stormwater system. It is proposed that a total of fifteen (15) proposed grated inlet stormwater pits be fitted with OceanGuard filter baskets. The OceanGuard is fitted with a monofilament 200 micron pore size filter bag that removes gross pollutants such as sediment, trash and debris, as well as suspended solids; please refer to Figure 6.1 for an illustration of a typical OceanGuard.

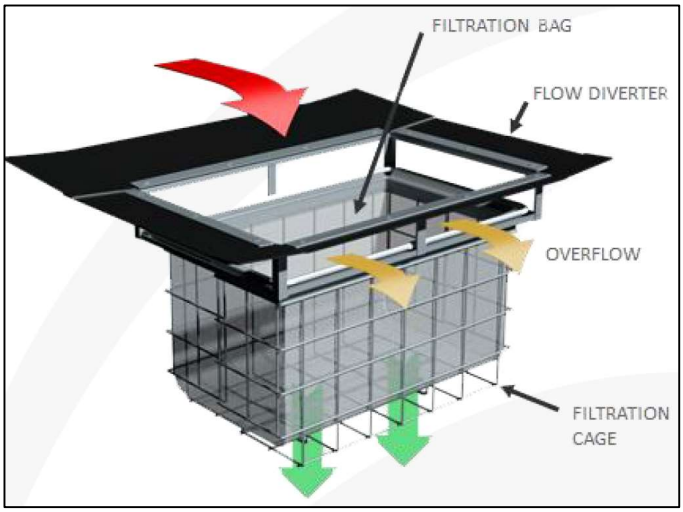

Figure 6.1: Typical Enviropod Filter

The second level of treatment includes a stormfilter system that will be contained within a sectioned area of the OSD storage tank or treatment pits. To achieve the reduction targets, it is proposed that a total twenty-three (23) Ocean Protect 690mm PSORB Stormfilters be installed throughout the proposed stormwater system, as follows:

- Fourteen (14) Stormfilters will be fitted in the OSD tank treatment chamber;
- Three (3) StormFilters will be fitted in the treatment stormwater pit within the property, located immediately upstream of the Neild Avenue discharge connection point, and;
- Six (6) StormFilters will be fitted in the treatment stormwater pit within the property, located immediately upstream of the DN600 stormwater deviation connection point.

A Psorb Stormfilter cartridge system is provided to remove any remaining suspended sediments and nutrients which have entered the stormwater system; please refer to Figure 6.2 for an illustration of a typical Psorb stormfilter.

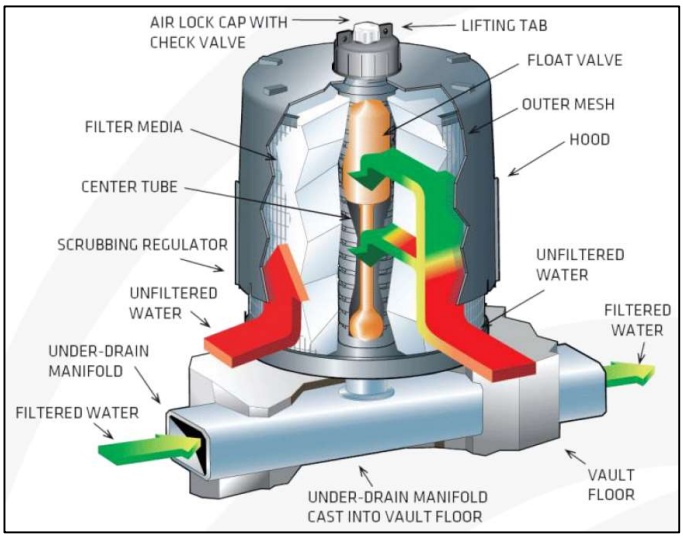

Figure 6.2: Typical PSorb Stormfilter

It is proposed that one OceanGuard basket located in the eastern external carpark will be fitted with one (1) Oil Soak supplied by MyCelx. This product permanently removes oil and hydrocarbons from stormwater runoff. Refer to Figure 6.3 for an example of an installed oil sock.

Figure 6.3: Installed Oil Sock

Refer to Figure 6.4 MUSIC Model Treatment Plan for the location of the OceanGuard and oil soak.

6.4 STORMWATER RETENTION

For the proposed development, it is proposed that a 100kL volume rainwater reuse tank be provided in order to retain stormwater for WC flushing and irrigation purposes. The overflow from the proposed rainwater reuse tank will discharge into the OSD system. The following average demand assumptions presented in Table 6.5 have been considered in the MUSIC modelling.

Table 6.5: Average Water Demand

Use	Average Water Demand
WC Flushing	1080 L/day
Turf Irrigation	1,857.6 kL/year

6.5 MUSIC MODEL TREATMENT RESULTS

The stormwater quality treatment system has been modelled using the MUSIC software. Please refer to Figure 6.4 for the treatment plan, Table 6.6 for the treatment result and Schedule 1 for the detailed MUSIC modelling output.

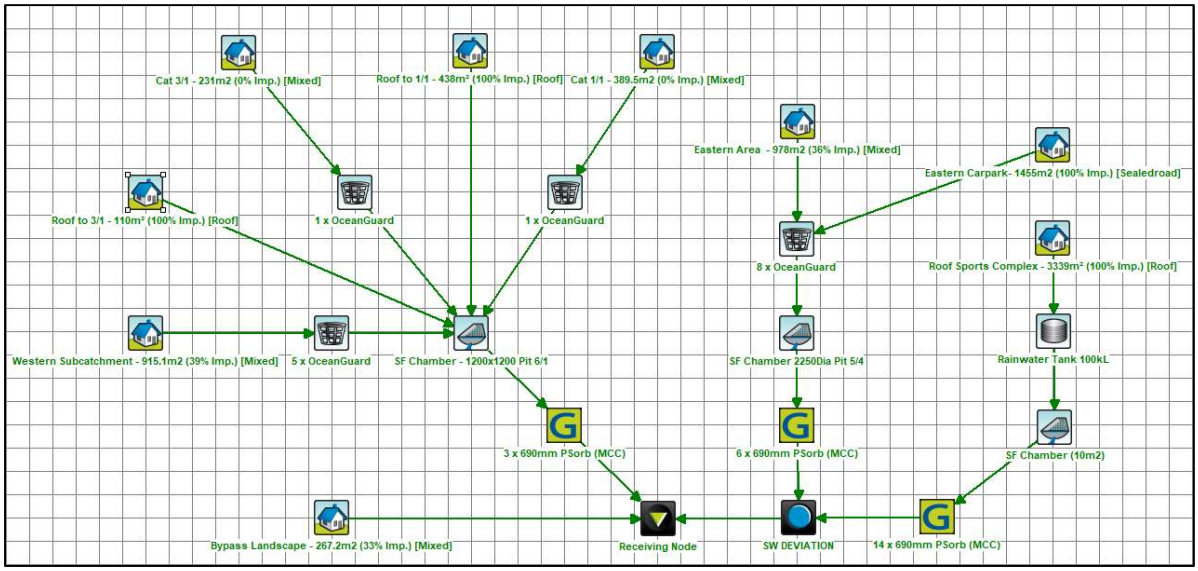

Figure 6.4: MUSIC Model Treatment Plan

Table 6.6: Percentage Based Load Reduction in Pollutant Results

Pollutant Type	Source (kg/yr)	Residual Load (kg/yr)	Reduction % Achieved	Reduction % Target
Gross Pollutants (GP)	197	3.97	**98**	**90**
Total Suspended Solids (TSS)	1620	140	**91.4**	**85**
Total Phosphorus (TP)	2.54	0.881	**65.3**	**65**
Total Nitrogen (TN)	18.3	8.9	**51.3**	**45**
TPH (kg/yr)	29.6	1.6	**94.6**	**60**
Free Oil (kg/yr)	28.80	2.84	**90.1**	**90**

7. SEDIMENT AND EROSION CONTROL

The Contractor for the works is required to provide Sedimentation and Erosion Control in accordance with the general requirements outlined below.

7.1 SITE PROTECTION MEASURES

It is proposed to provide the following in order to inhibit the movement of sediment off the site during the demolition and construction phases.

7.1.1 SITE ACCESS

Construction vehicles leaving the site shall be required to pass over a Temporary Construction Vehicle Entry consisting of a 1.5m long by 3m wide 'cattle rack'.

7.1.2 SEDIMENT CONTROL

All exposed earth areas where it may be possible for runoff to transport silt down slope shall be protected with a sediment and erosion control silt fence generally installed along the boundaries of the site.

The fence will be constructed in accordance with details provided by the Department of Conservation and Land Management incorporating geotextile fabric which will not allow suspended particles greater than 50mg/L non-filterable solids to pass through, and as such comply with the appropriate provisions of the Clean Waters Act 1970.

The construction of the silt fence will include the following:-

- Geotextile fabric buried to a maximum of 100mm below the surface;
- Overlapping any joins in the fabric, and;
- Turning up on the ends for a length of 1 metre in order to prevent volumes of suspended solids escaping in a storm event.

Please refer to Figure 7.1 for details.

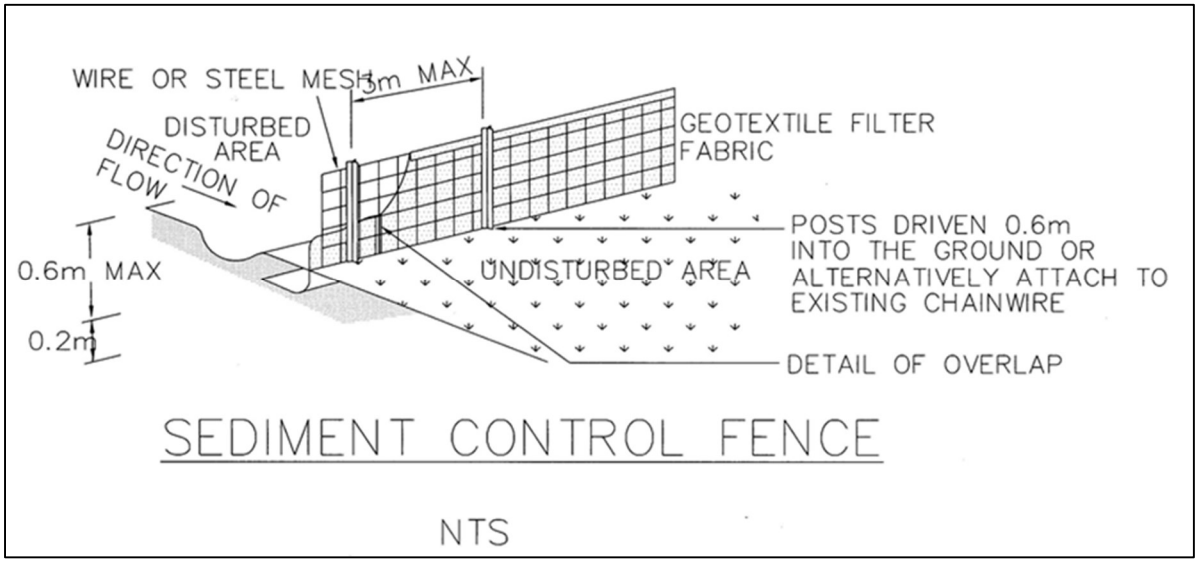

Figure 7.1: Sediment Control Fence Illustration

Existing stormwater infrastructure is also to be protected from incoming sediment using the following methods:

- Any Council owned road kerb entry and/or gully pits will be protected by Filter Bales and EcoSocks. Additional protection will be provided by inserting Water Clean Filter Cartridges into the gully opening, and;
- Internal site drainage pits shall be protected by Sediment Traps consisting of hay bales.

Please refer to Figure 7.2, Figure 7.3 and Figure 7.4 for details.

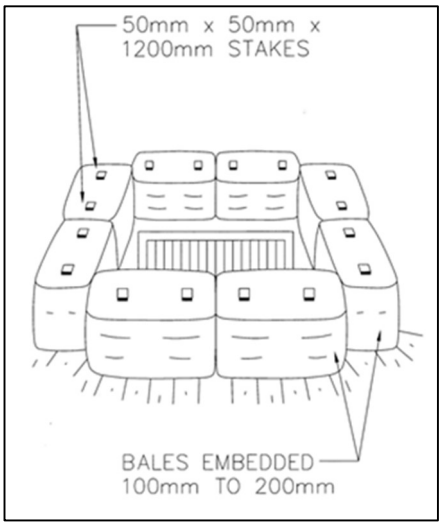

Figure 7.2: Stormwater Pit Sediment Trap (NTS)

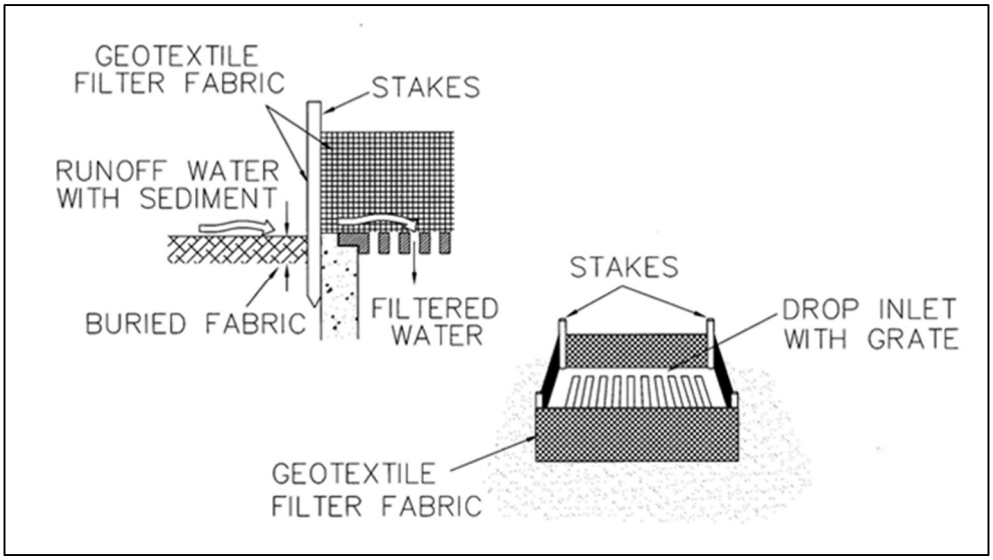

Figure 7.3: Geotextile Filter Fabric Drop Inlet Sediment Trap (NTS)

What are FilterBales?

Water Clean FilterBales are a unique new patented 7 stage sediment filter device developed to substantially reduce the migration of sediment and contaminants into drainage systems while allowing filtered water to easily pass through. FilterBales reduce customers' time and money by providing solutions to comply witht environmental and regulatory requirements.

Durable, Dependable, Reusable.
Replacing hay bales and other inadequate attempts to stop sediment run-off, FilterBales are durable and re-useable, effectively stopping your money from "pouring down the drain". They are also lightweight and easy to handle. Replaceable Water Clean Filter Cartridges guarantee peak performance is maintained.

Ask your local FilterBales stockist about replacement frequencies in your area. Cartridges and filter covers should be changed when the infiltration rate decreases. Water Clean FilterBales are suitable for a wide range of sediment and water management situations and can be easily secured in place for long term use. The unique multi-directional filter system allows you to position Water Clean FilterBales in any direction without reducing performance.
Water Clean FilterBales can be fixed to concrete or bitumen surfaces using an epoxy mortar-binder or fixed to earth surfaces using 6-10 mm pegs or stakes. When positioning, the side with the red reflective marker should be facing traffic.

1. FilterBales frames are a perforated plastic structure made from recycled wheelie bins, battery cases, milk bottles etc.

2. Filter medium (bio engineered soil media) used in the filter cartridges is made from a special blend of recycled organic (RO) materials from kerbside and vegetation drop off centres. The RO hosts enhanced naturally occurring micro-organisms. The blend also contains natural minerals to capture nutrients. The filter medium is as safe as normal soil.

3. FilterBales have a seven (7) stage filtration system:

1. In through the filter bag
2. Through the perforated plastic structure wall
3. In through the filter cartridge bag
4. Through the bio engineered filter medium
5. Out through the filter cartridge bag
6. Out through the perforated plastic structure wall
7. Out through the filter bag

4. The filter bag is made from 300-micron (one third of a millimetre) pore size geotextile. This is the first stage that filters much of the sediment and other suspended solids from the run-off water. The geotextile is designed to stop sediment and reduce clogging but allow water to pass through easily. The filter cartridge bags are made from a similar geotextile.

5. FilterBales work effectively up to "a one-in-one-year 48 hours, 100 mm "storm events". This is the largest storm event experienced since the commercialisation of FilterBales. Having handled this easily, Filter Bales are considered capable of handling much greater "storm events'. During these storm events FilterBales were used inside gully pits in one application and on the ground surrounding the gully pit in another application.

6. EcoSocks are made from a similar geotextile to the filter cartridge bags and contain the same bio engineered soil media as the FilterBales. They appear able to stand up to as much wear and tear as a sandbag.

7. FilterBales are much lighter (at around 15 kgs dry weight) than hay bales. This reduces exposure to Occupational Health and Safety problems

Product Range

Item No.	Description	
HFB001	**High FilterBale,** suitable for high flow situations and higher retention time applications. Contains two standard size WaterClean Filter Cartridges in upright formation to treat contaminated waters. (605mm x 485mm x 460mm)	
LFB002	**Low FilterBale,** suitable for low flow situations and kerb & gutter applications. Multi-directional module containing two standard size WaterClean Filter Cartridges. (605mm x 485mm x 220mm)	
ESF004	**Directional EcoSock,** can be used in conjunction with FilterBales to direct water. Will also provide some sediment filtration from seepage through bio-remediating media contained within the EcoSock (1135mm x 160mm x 30mm)	

Accessories

Item No.	Description	
FCR004	**WaterClean Filter Cartridges** contain a unique blend of fixating and bio-remediating products that treat common pollutants. To achieve maximum performance, each FilterBale uses two WaterClean Filter Cartridges. (440mm x 400mm x 100mm)	
HBC005 (High bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	
HBC006 (Low bale)	**Replaceable FilterBale covers,** made from specially designed geotextile. FilterBale covers have a standard aperture of 300 microns.	

Figure 7.4: Erosion Control Filter Products

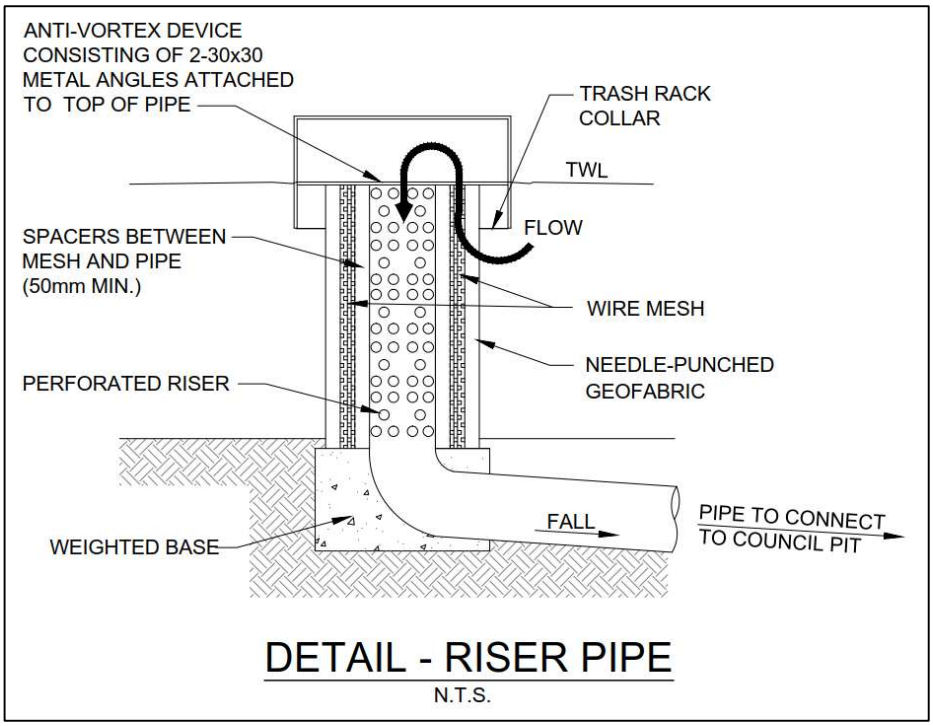

Figure 7.5: Sediment Basin Outlet Pipe Detail

7.2 TEMPORARY STORMWATER SYSTEM (WHERE REQUIRED)

Site runoff within the zones of the excavation will be drained into a central holding well within the excavation. Runoff will be allowed to settle out suspended particles and debris, and an acceptable water of 50mg per litre of Non Filterable Residues (NFR) is required to be achieved prior to discharge.

7.2.1 DUST CONTROL

The following dust control procedures will be adhered to:

- Loose loads entering or leaving the site will be securely covered by a tarpaulin or like material in accordance with RMS and local Council Guidelines.
- Soil transport vehicles will use the single main access to the site.
- There will be no burning of any materials on site.
- Water sprays will be used across the site to suppress dust. The water will be applied either by water sprinklers or water carts across ground surfaces whenever the surface has dried out and has the potential to generate visible levels of dust either by the operation of equipment over the surface or by wind. The watercraft will be equipped with a pump and sprays.
- Spraying water at the rate of not less than three (3) L/s and not less than 700kPa pressure. The area covered will be small enough that surfaces are maintained in a damp condition and large enough that runoff is not generated. The water spray equipment will be kept on site during the construction of the works.
- During excavation all trucks/machinery leaving the site will have their wheels washed and/or agitated prior to travelling on Council Roads.
- Fences will have shade cloth or similar fabric fixed to the inside of the fence.

7.2.2 MAINTENANCE

Generally, the following maintenance measures shall be adhered to during construction:-

- It will be the responsibility of the contractor to ensure sediment and erosion control devices on site are maintained. The devices shall be checked daily and the appropriate maintenance undertaken as necessary.
- Prior to the closing of the site each day, the road shall be swept and materials deposited back onto the site.
- Gutters and roadways will be kept clean regularly to maintain them free of sediment.
- Appropriate covering techniques, such as the use of plastic sheeting will be used to cover excavation faces, stockpiles and any unsealed surfaces;
- If dust is being generated from a given surface, and water sprays fail;
- If fugitive emissions have the potential to cause the ambient as quality to foul the ambient air quality;
- The area of soils exposed at any one time will be minimised wherever possible by excavating in a localised progressive manner over the site; and,
- Materials processing equipment suitably comply with regulatory requirements. The protection will include the covering of feed openings with rubber curtains or socks.

It is considered that by complying with the above, appropriate levels of protection are afforded to the site, the adjacent public roads, footpaths and environment.

SCHEDULE 1 MUSIC MODELLING RESULTS

Receiving Node

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Treatment Train Effectiveness

	Flow (ML/yr)	TSS (kg/yr)	TP (kg/yr)	TN (kg/yr)	Gross Pollutants (kg/yr)
Sources	8.21	1.62E3	2.54	18.3	197
Residual Load	6.45	140	0.881	8.90	3.97
% Reduction	21.4	91.4	65.3	51.3	98.0